Submission of Ph.D. Synopsis / Work Plan for Ph.D.

by

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Abstract of Proposed Work Plan/Problem:

Title: Weight Distribution of Linear Codes from Finite Geometry

Recently, Algebraic Coding theory has become interested topic of research for many researchers in the area of algebra, algebraic geometry, number theory, etc. Linear codes constructed from algebraic curves found to be the best codes in the sense that their error detection correction capabilities are better than the conventional codes. Let $\mathbb{F}_q$ denote the finite field with q elements, where $q = p^h$, p is any prime number, and h is positive integer. A k dimensional subspace of vector space $\mathbb{F}_q^n$ over $\mathbb{F}_q$ is called an $[n, k]_q$ linear code. The number n is called length and k is called dimension of this code. There are other important parameters associated to linear code such as minimum distance, weight distribution, generalized spectrum of linear codes. The linear codes from algebraic curves/varieties such as Hermitian curves, Klien quadrics, arcs and caps, Grassmannians, etc. have been studied by many researchers.

I wish to pursue my research in Algebraic Coding Theory. In particular, my interest lies in the the study of parameters like length, dimension, weight distribution, spectrum of some of the linear codes generated by the algebraic varieties such as Hermitian varieties, Grassmannians, Schubert varieties, flag varieties.

1. **Introduction**

   Consider the projective plane curve C defined over the finite field $\mathbb{F}_\ell^2$ by the affine equation $f(X, Y) = y^\ell + y - X^{\ell+1} \in \mathbb{F}_{\ell^2}[X, Y]$ with genus $g = \frac{\ell(\ell-1)}{2}$. Some of the

higher weights of linear codes arising from these varieties are known. I am interested to determine the generalized spectrum of these codes and would like consider it as a Ph.D. problem.

2. **Review of Literature and Development in the Subject (previous work done in the relevant area):**

   Through various papers, text books and monographs mentioned in the list of references the problem of weight distribution of linear codes associated with hermitian varieties is well studied. Luca Giuzzi [**?**] describes the Hermitian Varieties over finite fields. I proceed with the work of Luca Giuzzi and the text book written by Hirschfeld and Thas [**?**] to start my doctoral work.

3. **Objectives of Research/Proposed Hypothesis:** The main objective of my research during Ph.D. is to work on the following open problems:

   (i) Determine the Generalized Spectrum of linear codes associated with Hermitian varieties

   (ii) Weight Distribution of these codes

4. **Methodology to be adopted:** My area of research is theoretical in nature. Mostly, I will be referring the text books and research papers of various researchers who have developed this area of research. I would also like to consult with my thesis supervisor time to time to discuss the doubts. I would also like to participate in the schools, seminars, workshops in my area of research, which will help me to strengthen my knowledge in my field of research.

5. **Importance of study/Society Application** The area of my research is highly applicable in communication theory. Linear error correcting codes defined by algebraic

varieties are now a days an essential component to any essential communication system, as they can be used in order guarantee arbitrarily low probability of mistakes in the repetition of messages without requiring noise free operation.

6. **Proposed Work Plan/Formulation and Structure of study:** Following is the Year-wise plan of work and target to be achieved during my research period:

Year 1 Course work: I would like to complete the course work which is declared by SRTMU Nanded. Then after, I would like to read the following text books to develop necessary background for my research:

(i) Dummit and Foote, Abstract Algebra, Wiley Publication

(ii) M. Artin, Algebra, Pearsons Publication

(iii) Lidle, Niederriter, Finite Fields and Their Applications, Springer Publications

Year 2: I would like to read the following text books:

(i) M. Atiyah, I. Macdonals, Commutative Algebra

(i) Fulton, Algebraic Curves

(i) M. Tsfasmann, and Vladut, Algebraic Geometric Codes: Basic Notions, American Mathematical Society.

(i) J.W.P. Hirschfeld and J. A. Thas, General Galois Geometries, Oxford Mathematical Monographs

(i) Lucca Giuzzi, Hermitian Varieties over Finite Fields

Year 3: I will start reading the research papers of various researchers in the area of my research topic and then decide the problem to solve for Ph.D.

Year 4: I will focus on solving my research problem.

References

[1] Dummit and Foote, *Abtsract Algebra,* Wiley Publication

[2] I. Cardinali and L. Giuzzzi, *Caps and Codes from Orhogonal Grassmannians,* Finite Fieldas and Appl. 24 (2013), 148-169.

[3] I. Cardinali and L. Giuzzzi, *Caps and Codes from Orhogonal Grassmannians,* Finite Fieldas and Appl. 24 (2013), 148-169.

[4] Lucca Giuzzi, Hermitian Varieties over Finite Fields

[5] J. W. P. Hirschefeld and J. A. Thas, *General Galois Geometries*, Oxford Mathematical Monographs

[6] D. Yu. Nogin, *Codes associated to Grassmannians*, Arithmetic, Geometry and Coding Theory R. Pellikan, M. Perret, S.G. Vlăduţ. Eds., 145-154, Walter de Gruyter, Berlin/ New York, 1996.

[7] C. T. Ryan, K. M. Ryan, *The minimum weight of the Grassmann codes* $C(k, n)$, Discrete Appl. Math. **28**, 149-156, 1990.

[8] Lidle, Niederriter, Finite Fields and Their Applications, Springer Publications